



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/616,097	07/08/2003	Zhi-Wen Sun	AMAT/8241/CMP/ECP/RKK	1645
44257 7590 07/13/2007 PATTERSON & SHERIDAN, LLP 3040 POST OAK BOULEVARD, SUITE 1500 HOUSTON, TX 77056			EXAMINER WONG, EDNA	
			ART UNIT 1753	PAPER NUMBER
			MAIL DATE 07/13/2007	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/616,097

Applicant(s)

SUN ET AL.

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 June 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 8-10,20-22,31-33 and 37-60 is/are pending in the application.
- 4a) Of the above claim(s) 60 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 8-10,20-22,31-33 and 37-59 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 28, 2007 has been entered.

This is in response to the Amendment dated June 28, 2007. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Claim Rejections - 35 USC § 103

I. Claims **8-9 and 37-44** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1).

The rejection of claims 8-9 and 37-44 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28,

Art Unit: 1753

2007 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that Miura does not teach or suggest electrolytic copper plating a copper seed layer. In contrast, Miura teaches that a prior deposited copper seed (deposited by CVD or PVD process) must be present to enable the subsequent electrolytic copper plating process.

In response, Miura teaches depositing a copper seed layer by PVD (page 4, [0050]). Wang shows a copper seed layer deposited by PVD in Fig. 4 (col. 2, lines 49-65):

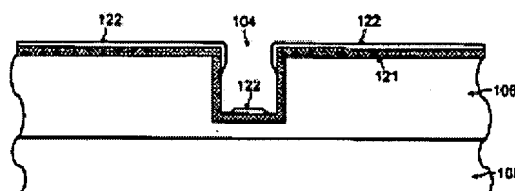


FIG. 4 (Prior Art)

Miura teaches that the electrolytic copper plating solution of his invention reinforces the seed layer and adds thickness to the seed layer within the trenches or via holes of silicon wafers so that a highly acidic or highly basic copper plating bath, which would otherwise corrode the seed layer, can be used to plate the silicon wafer (page 4, [0051]). Wang shows a seed layer enhancement layer **130** that is electrochemically deposited conformally to continuously cover substantially all exposed surfaces within the interconnect opening **104** in Fig. 5 (col. 2, line 66 to col. 3, line 12):

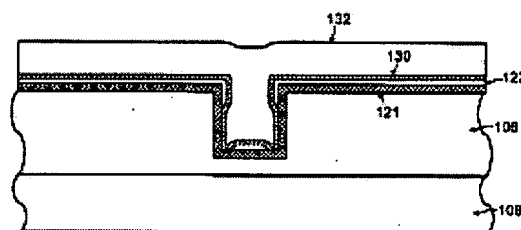
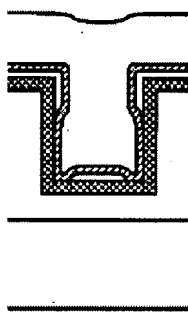


FIG. 5 (Prior Art)

In a closer look, the electrochemically deposited seed enhancement layer **130** is deposited directly on the diffusion barrier material **121**:



The methods recited in claims 8, 20 and 31 are open to depositing a copper seed layer by CVD or PVD prior to exposing the substrate to a first copper solution.

The steps of exposing the substrate to a complexed copper solution and exposing the substrate to a first electrical bias as presently claimed reads on forming a reinforced and thickened copper seed layer.

Thus, the reinforced and thickened copper seed layer disclosed by Miura would have enabled the subsequent electrolytic copper plating process.

Applicants state that the subsequent electrolytic copper plating process described by Miura is used to deposit bulk copper layer to fill in the vias/trenches, not

depositing a seed layer. The subsequent electrolytic copper plating process is merely enhancing the thickness of a prior deposited copper seed layer and the electrolytic copper solution is selected at a suitable range to prevent the existing seed layer from dissolved, thereby preventing the thickness of the seed layer being reduced while immersing in the electrolytic copper solution.

In response, Wang teaches forming the seed enhancement layer **130** by ECD (electrochemical deposition) and then plating copper fill **132** from the seed enhancement layer **130** and the seed layer **122**.

It is within the skill of one having ordinary skill in the art to add a step or split one step into two because the transpositioning of varying steps, or varying the details of a process, as by adding a step or splitting one step into two does not avoid obviousness where the processes are substantially identical or equivalent in terms of function, manner and result. *General Foods Corp. v. Perk Foods Co.* (DC NIII 1968) (157 USPQ 14); *Malignani v. Germania Electric Lamp Co.*, 169 F. 299, 301 (D.N.J. 1909); *Matrix Contrast Corp. v. George Kellar*, 34 F.2d 510, 512, 2 USPQ 400, 402-403 (E.D.N.Y 1929); *Hammerschlag Mfg. Co. v. Bancroft*, 32 F. 585, 589 (N.D.III.1887); *Procter & Gamble Mfg. Co. v. Refining*, 135 F.2d 900, 909, 57 USPQ 505, 513-514 (4th Cir. 1943); *Matherson-Selig Co. v. Carl Gorr Color Gard, Inc.*, 154 USPQ 265, 276 (N.D.III.1967).

Applicants state that since Miura specifically teaches the subsequent electrolytic

copper plating process cannot be performed without the electric current provided through the seed layer, Miura can not teach or suggest electrolytic copper plating of seed layer, as asserted by the Examiner. Miura specifically teaches using seed layer deposited by a PVD or CVD process to enable the subsequent electrolytic copper plating process, as the uniform electric current prevents forming of void and defects during the subsequent electrolytic copper plating process. Therefore, Miura does not teach or suggest depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application.

In response, Miura teaches that the electrolytic copper plating solution of his invention reinforces the seed layer and adds thickness to the seed layer within the trenches or via holes of silicon wafers so that a highly acidic or highly basic copper plating bath, which would otherwise corrode the seed layer, can be used to plate the silicon wafer (page 4, [0051]). Wang shows a seed layer enhancement layer **130** that is electrochemically deposited conformally to continuously cover substantially all exposed surfaces within the interconnect opening **104** in Fig. 5 (col. 2, line 66 to col. 3, line 12):

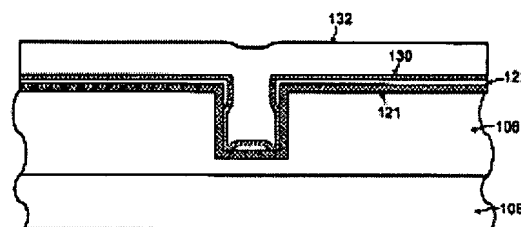
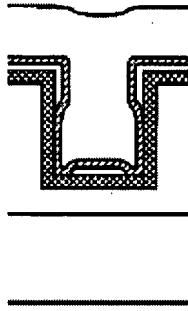


FIG. 5 (Prior Art)

In a closer look, the electrochemically deposited seed enhancement layer **130** is deposited directly on the diffusion barrier material **121**:



Thus, when Miura electrolytically plates copper, the copper would have filled the exposed surfaces within the interconnect opening, and thus, would have been deposited on the barrier layer.

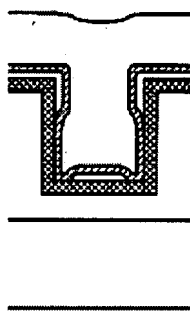
Applicants state that in the present application, the claims have not been interpreted in a manner consistent with the specification nor in a manner consistent with an interpretation that would be utilized by those skilled in the art. In particular, a skilled artisan would not interpret using a PVD or CVD deposited seed layer which enables a subsequent electrolytic copper plating process as taught by Miura to be suggestive of depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application. Therefore, the Applicants submit that the Examiner has neglected to consider how one skilled in the art would interpret the claim language in light of the specification.

In response, the methods recited in claims 8, 20 and 31 are open to depositing a copper seed layer by CVD or PVD prior to exposing the substrate to a first copper solution.

The steps of exposing the substrate to a complexed copper solution and exposing the substrate to a first electrical bias as presently claimed reads on forming a reinforced and thickened copper seed layer.

Wang teaches forming the seed enhancement layer **130** by ECD (electrochemical deposition) and then plating copper fill **132** from the seed enhancement layer **130** and the seed layer **122**.

Thus, one having ordinary skill in the art would have been taught or suggested by Miura and Wang to deposit a copper seed layer by PVD, reinforce the PVD copper seed layer by electrochemically depositing copper, and copper filling from the reinforced seed layer, where Wang teaches that when reinforcing the PVD copper seed layer by electrochemically depositing copper, copper is deposited on the barrier layer (Fig. 5):



Applicants also state that neither Dubin nor Miura, alone or in combination, teaches or suggests depositing a copper seed layer onto a barrier surface by an electroplating process, as claimed in the present application.

In response, the rejection is not overcome by pointing out that one reference

Art Unit: 1753

does not contain a particular limitation when reliance for that teaching is on another reference. *In re Lyons* 150 USPQ 741 (CCPA 1966). Moreover, it is well settled that one cannot show nonobviousness by attacking the references individually where, as here, the rejection is based on a combination of references. *In re Keller* 208 USPQ 871 (CCPA 1981); *In re Young* 159 USPQ 725 (CCPA 1968).

Applicants state that the seed layer as taught by Wang is not deposited on a barrier layer. The seed layer as taught by Wang is deposited on a specifically selected adhesion skin layer, not on a barrier layer.

In response, Wang is relied upon for the teaching of the prior art (col. 2, line 49 to col. 3, line 12; and Figs. 4 and 5). His prior art teachings are used by the Examiner to elaborate on the method disclosed by the prior art of Miura (which follows Figs. 4 and 5 as schematically shown by Wang).

A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. V. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. Denied*, 469 U.S. 851 (1984), MPEP § 2141.02 and MPEP § 2123.

II. Claim 10 has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No.

Art Unit: 1753

6,528,412 B1) as applied to claims 8-9 and 37-44 above, and further in view of **Nagai et al.** (US Patent No. 6,709,563 B2).

The rejection of claim 10 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. as applied to claims 8-9 and 37-44 above, and further in view of Nagai et al. is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28, 2007 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that there is no teaching or suggestion from Nagai that would suggest to one of ordinary skill in the art to modify Miura, Dubin, and Wang in a manner that would yield depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by claim 8.

In response, the rejection is not overcome by pointing out that one reference does not contain a particular limitation when reliance for that teaching is on another reference. *In re Lyons* 150 USPQ 741 (CCPA 1966). Moreover, it is well settled that one cannot show nonobviousness by attacking the references individually where, as here, the rejection is based on a combination of references. *In re Keller* 208 USPQ 871 (CCPA 1981); *In re Young* 159 USPQ 725 (CCPA 1968).

Furthermore, there is no requirement that the motivation to make the combination be expressly articulated in one or more of the references. The teaching, suggestion or inference can be found not only in the references but also from knowledge generally available to one of ordinary skill in the art. *Ashland Oil v. Delta Resins* 227 USPQ 657

(CAFC 1985). The test for combining references is what the combination of disclosures taken as a whole would suggest to one of ordinary skill in the art. *In re McLaughlin* 170 USPQ 209 (CCPA 19710; *In re Rosselet* 146 USPQ 183 (CCPA 1960). References are evaluated by what they collectively suggest to one versed in the art, rather than by their specific disclosures. *In re Simon* 174 USPQ 114 (CCPA 1972); *In re Richman* 165 USPQ 509, 514 (CCPA 1970).

III. Claims **20-21 and 45-52** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1).

The rejection of claims 20-21 and 45-52 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28, 2007 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

IV. Claim **22** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination

Art Unit: 1753

with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1) as applied to claims 20-21 and 45-52 above, and further in view of **Nagai et al.** (US Patent No. 6,709,563 B2).

The rejection of claim 22 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. (US Patent No. 6,432,821 B1) and Wang et al. as applied to claims 20-21 and 45-52 above, and further in view of Nagai et al. is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28, 2007 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

V. Claims **31-32 and 53-58** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1).

The rejection of claims 31-32 and 53-58 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28, 2007 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VI. Claim **33** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1) as applied to claims 31-32 and 53-58 above, and further in view of **Nagai et al.** (US Patent No. 6,709,563 B2).

The rejection of claim 33 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. as applied to claims 31-32 and 53-58 above, and further in view of Nagai et al. is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28, 2007 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VII. Claim **59** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1), **Wang et al.** (US Patent No. 6,528,412 B1) and **Dubin** (US Patent Application Publication No. 2004/0108217 A1).

The rejection of claim 59 under 35 U.S.C. 103(a) as being unpatentable over

Art Unit: 1753

Miura et al. in combination with Dubin et al., Wang et al. and Dubin is as applied in the Office Actions dated May 15, 2006, October 17, 2006 and February 28, 2007 and incorporated herein.

The rejection has been maintained for the reasons following reasons:

Applicants state that Dubin ('217) teaches electroplating a copper layer for metal interconnection. However, there is not teaching or suggestion from Dubin ('217) that would suggest to one of ordinary skill in the art to modify Miura, Dubin and Wang in a manner that would yield depositing a copper seed layer onto a barrier surface by an electroplating process, as recited by claim 59.

In response, the rejection is not overcome by pointing out that one reference does not contain a particular limitation when reliance for that teaching is on another reference. *In re Lyons* 150 USPQ 741 (CCPA 1966). Moreover, it is well settled that one cannot show nonobviousness by attacking the references individually where, as here, the rejection is based on a combination of references. *In re Keller* 208 USPQ 871 (CCPA 1981); *In re Young* 159 USPQ 725 (CCPA 1968).

Furthermore, there is no requirement that the motivation to make the combination be expressly articulated in one or more of the references. The teaching, suggestion or inference can be found not only in the references but also from knowledge generally available to one of ordinary skill in the art. *Ashland Oil v. Delta Resins* 227 USPQ 657 (CAFC 1985). The test for combining references is what the combination of disclosures taken as a whole would suggest to one of ordinary skill in the art. *In re McLaughlin* 170

Art Unit: 1753

USPQ 209 (CCPA 19710; *In re Rosselet* 146 USPQ 183 (CCPA 1960). References are evaluated by what they collectively suggest to one versed in the art, rather than by their specific disclosures. *In re Simon* 174 USPQ 114 (CCPA 1972); *In re Richman* 165 USPQ 509, 514 (CCPA 1970).

Response to Amendment

Election/Restrictions

Newly submitted claim **60** is directed to an invention that is independent or distinct from the invention originally claimed for the following reasons:

Claim 60

lines 8-10, recite "exposing the substrate to an electroplating solution comprising complexed copper ions that have more negative deposition potential relative to free copper ions to deposit a copper seed layer directly on the barrier layer".

line 11, recites " thermally annealing the substrate in an environment containing hydrogen gas".

The method of claim 60 recites an independent and distinct method from the methods the were originally claimed. Claim 60 does not even claim applying an electrical bias as required by the originally method claims.

Since applicant has received an action on the merits for the originally presented

Art Unit: 1753

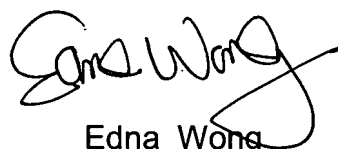
invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claim **60** is withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Art Unit: 1753

A handwritten signature in black ink, appearing to read "Edna Wong", with a stylized flourish extending from the end.

Edna Wong
Primary Examiner
Art Unit 1753

EW
July 6, 2007